Original Article

The Prevalence of Vitamin D Deficiency in Adult Thai Asthmatic Patients: A Study in a Tertiary Care Setting

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Background: Vitamin D deficiency is believed to play an important role in the pathophysiology of asthma. However, there has not yet been a study conducted in Thailand to examine the prevalence of vitamin D deficiency in adult asthmatic patients and its relationship with asthmatic activity.

Materials and Methods: A cross-sectional study was conducted in Thai asthmatic patients and healthy volunteers between June and October 2014 in a tertiary care setting. Age, gender, BMI, occupation, spirometry parameters, and 25-hydroxy-vitamin D levels (25(OH)D) were recorded in both groups. The authors then analyzed vitamin D status and its association with the prevalence of asthma and asthmatic activity.

Results: The present study included 72 patients with asthma and 98 controls. The prevalence of vitamin D deficiency (less than 20 ng/mL) and vitamin D insufficiency (20 to 30 ng/mL) were 8.3% and 34.7%, respectively in asthmatic patients and 6.1% and 40.8%, respectively in healthy patients. Serum 25(OH)D levels in asthmatic patients were slightly lower (32.7±10.1 ng/mL) than in controls (33.6±11 ng/mL), but without statistical significance (p=0.59). Among the asthmatic subjects, serum 25(OH)D levels were not significantly related to asthmatic activity.

Conclusion: The prevalence of vitamin D deficiency in adult Thai asthmatic patients is 8.3 percent. The authors did not detect significant differences in 25(OH)D levels between asthmatic patients and healthy subjects or between those with well-controlled versus inadequately-controlled asthma.

Keywords: Vitamin D deficiency, Prevalence, Asthma, Thai populations

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The role of vitamin D in the regulation of musculoskeletal health is well established[(1)]. Moreover, the effect of vitamin D on the immune system and immunological disorders, including asthma and hyperactive airway disorders, has also been demonstrated. Vitamin D regulates both innate and adaptive immunity by promoting phagocytosis and modulating the effects of T-helper 1 (TH1), T-helper 2 (TH2), and regulatory T cells[(2,3)], which play important roles in asthma pathology[(4,5)]. The 25-hydroxy-vitamin D (25(OH)D) is a major circulatory precursor of vitamin D and a representative biomarker of vitamin D status in humans. A study in Canada in subjects aged 13 to 69 years found that those with 25(OH)D levels below 20 ng/mL were 50 percent more likely to have asthma than those with levels between 20 and 30 ng/mL[(6)]. Some epidemiological studies in children and adolescents have shown a correlation between low 25(OH)D levels and increased airway hyperresponsiveness (AWH), declined pulmonary function, worse asthma control, and steroid resistance[(7-15)]. However, other studies have failed to confirm these findings[(16-18)]. Meta-analysis has shown varied findings with regard to the correlation between 25(OH)D and asthma incidence, asthma control, and lung functions[(19)]. In addition, the role of vitamin D supplementation in the reduction of asthma severity is also debated. A current systematic review found that taking an oral vitamin D supplements in addition to standard asthma medication is likely to reduce severe asthma attacks in patients with mild

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to moderate asthma[20]. However, it is still unclear whether this benefit is related to baseline 25(OH)D levels in these patients.

Vitamin D deficiency, defined by 25(OH)D levels less than 20 ng/mL, is a major public health problem worldwide. A study conducted as part of the United States' National Health and Nutrition Examination Survey (NHANES) found that almost 40 percent of the healthy population in the country suffered from vitamin D deficiency[21]. A study in Thailand found the prevalence of vitamin D deficiency and vitamin D insufficiency to be 32.6 and 5.7 percent, respectively[22]. A report in pediatric Thai asthmatic patients revealed a high prevalence of vitamin D deficiency (19.2%) and insufficiency (44.8%)[23]. However, there has been no report on the prevalence of vitamin D deficiency among adult asthmatic patients in Thailand. Therefore, the present study aimed to determine the prevalence of vitamin D deficiency and insufficiency in Thai asthmatic adults compared to non-asthmatic volunteers, and to further examine the association between 25(OH)D levels and asthmatic activity.

Materials and Methods

The present cross-sectional study was conducted in a tertiary care setting (Khon Kaen University's Srinagarind Hospital) between June and October 2014. Asthmatic patients aged 18 years and older were recruited from the outpatient unit by random sampling, as were gender- and age-matched healthy volunteers from the annual check-up clinic (control group). Clinical diagnosis was confirmed in both asthmatic patients and controls based on spirometry parameters according to Global Initiative for Asthma (GINA) guidelines using either a bronchodilator or methacholine bronchial challenge test[24]. Patients were excluded if they had been diagnosed with any other chronic lung diseases, active pulmonary tuberculosis, any diseases that affects calcium or vitamin D metabolism (such as renal failure, hepatitis, or infiltrative liver diseases), or epilepsy. In addition, patients who were pregnant or lactating, currently using vitamin D or calcium supplementation, or had used glucocorticoids within six months prior to the date of 25(OH)D measurement were excluded. Demographic characteristics (age, gender, body mass index [BMI], and occupation), 25(OH)D levels, and spirometry parameters were recorded. Asthmatic control status in asthmatic patients was classified as either well-controlled and inadequately-controlled, where inadequately-controlled asthma was defined as partly-controlled or uncontrolled asthma as specified in the GINA criteria[24]. Serum 25(OH)D levels were measured at 8.00 to 11.00 AM by electro-chemiluminescence immunoassay (ECLIA). Vitamin D status was defined as vitamin D deficiency (less than 20 ng/mL), insufficiency (20 to 30 ng/mL), and sufficiency (30 ng/mL or more) according to the criteria described by the Endocrine Society's clinical practice guidelines[25]. The present study was approved by the Khon Kaen University Ethics Committee. All participants provided written informed consents before entering the study.

Statistical analysis

Data for baseline characteristics were expressed as mean and standard deviations (SD) or percentages. An unpaired t-test was used to compare continuous variables between groups. A chi-square or Fisher's exact test was used to compare categorical variables between groups when appropriate. A probability value of less than 0.05 was considered statistically significant. All analyses were performed using SPSS predictive analytics software version 19.

Results

The present cross-sectional analytical study included 72 patients with asthma and 98 controls. Asthmatic patients were, on average, older than the healthy controls, but there was no difference between the two groups in terms of gender or BMI. Mean serum 25(OH)D levels were slightly lower in the asthmatic patients (32.7±10.1 ng/mL) than in the controls (33.6±11 ng/mL), but this difference was not significant (p=0.59). The prevalence of vitamin D deficiency, insufficiency, and sufficiency were 8.3, 34.7, and 57.0 percent, respectively, in those with asthma versus 6.1, 40.8, and 53.1 percent, respectively in those without asthma, differences that were not statistically significant (Table 1).

Among the asthmatic subjects, serum 25(OH)D levels were not significantly related to asthma control activity (well-controlled 33.4±11.1 ng/mL, inadequately-controlled 31.4±8.3 ng/mL, p=0.44). However, asthmatic patients with vitamin D insufficiency and deficiency (less than 30 ng/mL) had less FEV1, and fewer of these patients had well-controlled asthma (54.8%) as compared to those with vitamin D sufficiency (70.7%), but there was no statistically significant difference (Figure 1).

However, well-controlled asthmatic patients had a higher percentage of vitamin D sufficiency (63%) when compared to those with inadequately-controlled

Table 1. Characteristics of the study subjects

Characteristics	Asthma (n=72) Mean±SD	Control (n= 98) Mean±SD	p-value
Age (years)	57.1±12.9	52.2±11.6	0.01
Female, n (%)	51 (70.8)	57 (58.2)	0.09
BMI (kg/m^2)	25±4.3	24.8±4	0.72
FEV1 (%)	87.8±16.3	96.2±12.6	<0.01
FEV1/FVC	74±10.9	81.8±6.5	<0.01
25-hydroxy-vitamin D (ng/mL)	32.7±10.1	33.6±11	0.59
Vitamin D status, n (%)			0.67
Deficiency	6 (8.3)	6 (6.1)	
Insufficiency	25 (34.7)	40 (40.8)	
Sufficiency	41 (57.0)	52 (53.1)	

BMI=body mass index; FEV1=forced expiratory volume in 1 second; FVC=forced vital capacity; SD=standard deviation

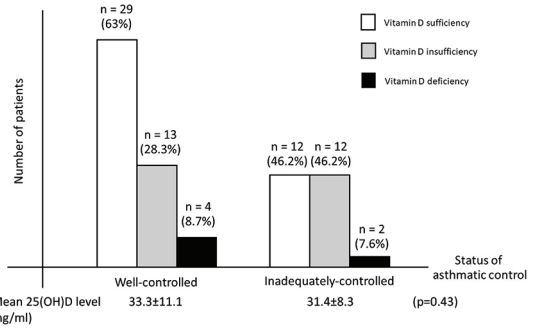

Figure 1. Vitamin D status of patients with well-controlled asthma compared with patients with inadequately-controlled asthma.

asthma (46.2%), but there was no statistically significant difference (Figure 1).

Discussion

The authors investigated the prevalence of vitamin D deficiency and insufficiency in Thai asthmatic adults and the association between vitamin D status and asthmatic activity in patients with asthma. The present study found that 8.3 and 34.7 percent of asthmatic patients had vitamin D deficiency and vitamin D insufficiency, respectively. These findings confirmed that vitamin D deficiency and insufficiency are common in patients with asthma and respiratory disease[26,27]. However, the prevalence of vitamin D deficiency in both asthmatic patients and healthy volunteers in the present study was lower than in other countries. For example, a study conducted in the US reported that 47.6 percent of asthmatics and 56.8 percent of normal control subjects had vitamin D deficiency[27]. This discrepancy may be due to geographical differences. Since the main source of vitamin D is solar ultraviolet B (UVB) in sunlight, abundant sun exposure can result in higher vitamin D status. Thailand is located near the equator and receives a large amount of sunlight throughout the year. Therefore, the prevalence of vitamin D deficiency should be lower in this region than in studies conducted in Western countries. This is supported by a study by Chailurkit et al, who reported only a 5.7 percent prevalence of vitamin D deficiency in Thailand with lowest percentage in the northeast, which has the most abundant sun exposure in the country[22].

In the present study, the authors did not detect any difference in 25(OH)D levels between the asthmatic patients and the healthy controls, which was consistent with the studies by Goleva et al[27] and Devereux et al[28]. The authors also explored the association between 25(OH)D levels and asthmatic activity. Although the patients with inadequately-controlled asthma tended to have slightly lower 25(OH)D levels and higher percentages of vitamin D deficiency and insufficiency, these differences were not statistically significant. These findings contrasted with those various reports showing that 25(OH)D levels were significantly lower in subjects with asthma and those with uncontrolled asthma symptoms[7-15]. This may be because the overall prevalence of vitamin D deficiency in Thailand is lower than in Western countries, which indicates that ethnic and geographical differences may play an important role in the linkage between vitamin D and asthma pathophysiology.

The major strengths of the present study were

that 1) it dealt with asthmatic patients with gender- and aged-matched controls taken from same region, 2) the clinical diagnosis was confirmed by both physical examination spirometry in both groups, which minimized any possibility of misdiagnosis, and 3) the authors excluded patients with a history of disease, as well as patients on any drugs that affected calcium or vitamin D metabolism.

However, the present study had a number of limitations. First, the relatively small number of subjects may have been inadequate to detect subtle differences between the groups and could have resulted in a type II error. Second, there are many factors that may influence serum 25(OH)D levels (i.e., sunscreen use, comorbidities, concomitant drug use, and dietary intake), which were not recorded in the present study. Third, the cross-sectional nature of the study limited the ability to determine a casual association between asthma control and 25(OH)D levels. This means that further experimental and clinical studies are needed to further clarify the relationship between vitamin D deficiency and asthma. Notwithstanding, the authors' findings confirmed that vitamin D deficiency and insufficiency are common in patients with asthma. In addition, the present study was conducted in a region with an abundance of sunlight and appeared to confirm the importance of geographical location in vitamin D status, which may encourage researchers to conduct larger studies on this topic.

In conclusion, the prevalence of vitamin D deficiency in adult Thai asthmatic patients was 8.3 percent. The authors did not detect significant differences in 25(OH)D levels between asthmatic patients and healthy subjects, nor among patients with different asthmatic control statuses.

What is already known on this topic?

Vitamin D deficiency is a common public health problem worldwide and plays important role in pathophysiology of immunological disorders, including asthma and hyperactive airway disorders.

What this study adds?

Vitamin D deficiency and insufficiency are common in adult Thai asthmatic patients. However, significant differences in 25(OH)D levels between healthy subjects, asthmatic patients, and among patients with different asthmatic control statuses, were not detected.

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Conflicts of interest

The authors declare no conflict of interest.

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